

PRELIMINARY  
INSTRUCTION BOOK  
MODEL 75D  
1 MHz Direct Capacitance Bridge

**BOONTON**  
**ELECTRONICS**  
CORPORATION

MP MASTER



MA24785



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IMPORTANT NOTE

This "Preliminary Operating Instruction Book" will be replaced by a permanent Operating and Maintenance Manual as soon as such becomes available. To assure placing the permanent instruction book into the proper hands, please fill out the request form which follows this page, and mail the form to us at the address below.

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PRELIMINARY  
INSTRUCTION BOOK  
MODEL 750  
100K Direct Conversion Bridge

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SECTION I  
General Information

1.1 SPECIFICATIONS

Capacitance Measurement:

Range: 0 to 1000 pF

| Multiplier | Capacitance Range, pF | Resolution, Phase Mode | Resolution, Amplitude Mode | Accuracy, Phase Mode                    | Accuracy, Amplitude Mode                    |
|------------|-----------------------|------------------------|----------------------------|-----------------------------------------|---------------------------------------------|
| 1.0        | 100 to 1000           | 0.2 pF                 | 0.2 pF                     | $\pm[(0.25 + 10/Q)\% + 0.5\text{pF}]^*$ | $\pm[0.25\% + (1000/R_p + 0.5)\text{pF}]$   |
| 0.1        | 10 to 100             | 0.02 pF                | 0.02 pF                    | $\pm[(0.25 + 5/Q)\% + 0.05\text{pF}]$   | $\pm[0.25\% + (1000/R_p + 0.05)\text{pF}]$  |
| 0.01       | 1 to 10               | 0.002 pF               | 0.002 pF                   | $\pm[(0.25 + 3/Q)\% + 0.005\text{pF}]$  | $\pm[0.25\% + (1000/R_p + 0.005)\text{pF}]$ |
| 0.001      | 0.05 to 1             | 0.0002 pF              | 0.0005 pF                  | $\pm[(0.25 + 3/Q)\% + 0.001\text{pF}]$  | $\pm[0.25\% + (1000/R_p + 0.001)\text{pF}]$ |
| 0.001      | 0 to 0.05             | 0.0002 pF              | 0.0005 pF                  | $\pm[(2 + 3/Q)\% + 0.0002\text{pF}]$    | $\pm[2\% + (1000/R_p + 0.0002)\text{pF}]$   |
| 0.0001     | 0 to 0.1              | 0.00005 pF             | 0.0005 pF                  | $\pm[(2 + 3/Q)\% + 0.00005\text{pF}]$   | $\pm[2\% + (1000/R_p + 0.00005)\text{pF}]$  |

Where  $R_p$  is the equivalent parallel resistance of the test in ohms.

\*Q must be 10 or greater



Inductance Measurement:

Range: 25  $\mu$ H to  $\infty$

| C Multiplier | Inductance Range          | Accuracy,<br>Phase Mode                           | Accuracy,<br>Amplitude Mode                      |
|--------------|---------------------------|---------------------------------------------------|--------------------------------------------------|
| 1.0          | 25 $\mu$ H to 250 $\mu$ H | $\pm(0.25 + \frac{30}{Q} + \frac{L\mu H}{500})\%$ | $\pm(0.25 + L + \frac{4000L}{R_p})\%$            |
| 0.1          | 250 $\mu$ H to 2.5 mH     | $\pm(0.25 + \frac{5}{Q} + \frac{L\mu H}{500})\%$  | $\pm(0.25 + \frac{L}{10} + \frac{4000L}{R_p})\%$ |
| 0.01         | 2.5 mH to 25 mH           | $\pm(0.25 + \frac{3}{Q} + \frac{LmH}{50})\%$      | $\pm(0.25 + \frac{L}{50} + \frac{4000L}{R_p})\%$ |

Where L = millihenries

$R_p$  = parallel resistance in ohms

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Conductance Measurement:Range: Amplitude mode only; 0 to 1000  $\mu$ hos

| Divider | Conductance Range     | Resolution    | Accuracy                                   |
|---------|-----------------------|---------------|--------------------------------------------|
| 1       | 100 to 1000 $\mu$ hos | 5 $\mu$ ho    | $\pm[(10 + \frac{Q}{500})\% + 10 \mu$ hos] |
| 10      | 10 to 100 $\mu$ hos   | 0.5 $\mu$ ho  | $\pm[(5 + \frac{Q}{500})\% + 1 \mu$ ho]    |
| 100     | 1 to 10 $\mu$ hos     | 0.05 $\mu$ ho | $\pm[(5 + \frac{Q}{500})\% + 0.1 \mu$ ho]  |
| 1000    | 0 to 1 $\mu$ ho       | 0.01 $\mu$ ho | $\pm[(5 + \frac{Q}{500})\% + 0.01 \mu$ ho] |

Resistance Measurement:Range: Amplitude mode only; 1000 $\Omega$  to 100M $\Omega$ 

| Multiplier | Resistance Range        | Resolution          | Accuracy                                     |
|------------|-------------------------|---------------------|----------------------------------------------|
| 1          | 1K to 10K               | $\frac{R}{10^3} \%$ | $\pm(10 + \frac{Q}{500} + \frac{R}{10^3})\%$ |
| 10         | 10K to 100K             | $\frac{R}{10^4} \%$ | $\pm(5 + \frac{Q}{500} + \frac{R}{10^4})\%$  |
| 100        | 100K to 1M $\Omega$     | $\frac{R}{10^5} \%$ | $\pm(5 + \frac{Q}{500} + \frac{R}{10^5})\%$  |
| 1000       | 1M $\Omega$ to $\infty$ | $\frac{R}{10^6} \%$ | $\pm(5 + \frac{Q}{500} + \frac{R}{10^6})\%$  |

Where R is the measured resistance in ohms.



Test Signal:

Frequency: 1 MHz ( $\pm 200$  Hz) crystal controlled  
Level: Continuously adjustable from 250 mV to 1 mV; to 15 mV for phase mode

DC Bias:

Internal: Continuously adjustable from -6V to +150V  
External, 2 Term: Up to  $\pm 400$ V @ 100 mA from HI post to LO post  
External, 3 Term: Up to  $\pm 400$ V @ 100 mA from HI to ground and LO to ground

Primary Power:

105 - 125V, 50/60 Hz  
210 - 250V, 50/60 Hz available

Physical Characteristics:

Overall (in cabinet): 11-1/4" h x 19-1/2" w x 12-3/4" d  
Without cabinet: 10-1/2" h x 19" w x 10-1/8" d  
(for rack mounting)  
Weight (with cabinet): 35 lbs.  
Weight (without cabinet): 25 lbs.



## SECTION II

### Operating Procedures

#### 2.1 CONTROLS AND THEIR FUNCTIONS

##### 2.1.1 CAPACITANCE pF

Main capacitance balance control. The "counter" dial plus vernier reads directly in pF. When the indicating hairline lies over the black portion of the counter dial, the black numerals on the vernier are used; when over the red portion, the red numerals are used.

##### 2.1.2 CONDUCTANCE

Main conductance balance control; calibrated in micromhos and ohms.

##### 2.1.3 MULTIPLY C

Provides 5 capacitance ranges in decade steps. The selected multiplying factor also equals the value in pF of a major division on the capacitance vernier scale.

##### 2.1.4 DIVIDE G/MULTIPLY R

Provides 4 decade ranges of conductance and resistance.

##### 2.1.5 C ZERO (COARSE and FINE)

Capacitance zero balance adjustments.

##### 2.1.6 R/G ZERO

Conductance zero balance adjustment.

##### 2.1.7 C/L

Permits either direct-reading capacitance measurements (C position) or determination of equivalent parallel inductance by computation (L position).

##### 2.1.8 PHASE

Provides adjustment of phase of unbalance signal to assure insensitivity of the phase-sensitive detector to the loss in the specimen. Phase adjustment is not required for amplitude measurements as the conductance is balanced out.

##### 2.1.9 TEST LEVEL

Provides continuous control of test signal level from 1 mV to 250 mV. Test signal should be set to maximum (full cw) unless a specific test signal level is required. For phase mode operation, the signal level should not be less than 15 mV. (Measured from LO TEST to ground.)



#### 2.1.10 GAIN

Adjusts the sensitivity of the detector for both phase and amplitude operation.

#### 2.1.11 ZERO LEFT/ZERO CENTER

Selects the mode of null detection. In ZERO LEFT position the NULL INDICATOR meter is amplitude sensitive and both capacitance and conductance are adjusted for a ZERO LEFT null. In the ZERO CENTER mode the meter is phase sensitive and need only be balanced for capacitance. Null is at zero center.

#### 2.1.12 ADJUST (DC BIAS)

Adjusts the level of dc bias (internal only); connections for metering internal bias voltage and current (MONITOR E and I) are located immediately to the right of the control.

#### 2.1.13 +INT/OFF/-INT/EXT (DC BIAS)

Selects positive or negative internal bias, or external bias. Connections for external bias are located to the right of this selector. With the shorting strap connected from the LO binding post to the ground binding post, external bias may be applied to the HI bridge terminal with respect to LO bridge terminal. When the shorting strap is removed, external bias may be applied from one external source to the HI bridge terminal with reference to ground; and from a second external source to the LO bridge terminal with reference to ground. When dual biasing is used the total potential between HI and LO posts must not exceed  $\pm 400V$ .

### 2.2 OPERATION

#### 2.2.1 Turn-on and Warm-up Procedure

Connect the bridge to an appropriate power source (refer to requirements on instrument's identification plate). A warm-up period of 15 minutes should be allowed for amplitude operation. For phase mode operation a one-hour warm-up should be allowed to assure thermal stabilization of the phase detector.

#### 2.2.2 Zero-Balancing the Bridge

The zero balance of the bridge should be checked and the bridge re-zeroed, if necessary, under each of the following circumstances:

- a. The instrument is turned on and has completed warm-up.
- b. The setting of either the MULTIPLY C or the DIVIDE G/MULTIPLY R selector is changed.



- c. The C/L selector is switched from one setting to the other.
- d. The level of the test signal or the gain of the detector is changed.
- e. Any change is made in the length or type of external test leads, or in the type of external test fixture.

To zero-balance the bridge, proceed as follows:

- a. Set the C/L switch to the C position if capacitance tests are to be made, or to the L position for inductance measurements.
- b. Set the MULTIPLY C and the DIVIDE G/MULTIPLY R switches in accordance with the range of the test. (See Table 4-1a or 4-1b.)
- c. Set the PHASE, C ZERO (COARSE & FINE) and R/G ZERO controls to "12 o'clock".
- d. Connect any external test leads and test fixture to be used to the REMOTE TEST receptacles.
- e. Set the main CAPACITANCE and CONDUCTANCE dials to zero (be sure that both the counter and vernier of the main capacitance dial are at zero).
- f. Set the TEST LEVEL control fully clockwise for maximum test signal level, unless a specific test level is desired. In such a case, the level may be set to the desired value by connecting a suitable VTVM (one of the Boonton Electronics 91 Series RF Voltmeters, or equivalent) between the LO post and ground and adjusting the TEST LEVEL control as required.
- g. Switch the ZERO LEFT/ZERO CENTER control to the ZERO LEFT mode.
- h. By successive adjustments of the C ZERO and R/G ZERO controls, bring the bridge to balance as indicated by a minimum reading on the NULL INDICATOR meter.

NOTE: When using the X1 DIVIDE G/MULTIPLY R range, it is advisable to deviate from the above procedure to zero balance conductance. On this multiplier range the R/G ZERO control is relatively insensitive in comparison to the main CONDUCTANCE dial. To zero balance conductance on this range, set the R/G ZERO to "12 o'clock" and balance with the main CONDUCTANCE dial. Balance should be achieved within  $\pm 1/2$  minor division from zero on the conductance scale.



If conductance readings are to be made in subsequent tests, the amount of offset from zero is added to, or subtracted from, the dial reading to obtain the correct value.

Table 4-1a

Control Settings for Amplitude Mode Measurements

| <u>C Test Range, pF</u> | <u>MULTIPLY C Setting</u> |
|-------------------------|---------------------------|
| 100 to 1000             | X1                        |
| 10 to 100               | X0.1                      |
| 1 to 10                 | X0.01                     |
| 0.1 to 1                | X0.001                    |
| 0 to 0.1                | X0.0001                   |

DIVIDE G/MULTIPLY R: If the general range of conductance of the specimen is known, set this multiplier accordingly. Otherwise, start at X1000 and work down until a reading is obtained between 100 and 1000 on the scale.

- i. If amplitude measurements are to be made, the instrument is now zero balanced and ready for operation.
- j. If phase sensitive measurements are to be made, it is now necessary to switch to the ZERO CENTER mode. There may be a slight shift in balance between ZERO LEFT and ZERO CENTER modes, (not greater than approximately one major division on main CAPACITANCE dial). If so, adjust C ZERO to balance NULL INDICATOR exactly at center of scale (red mark).
- k. PHASE is now adjusted to make the detector insensitive to changes in conductance. To adjust PHASE, the main CONDUCTANCE dial is offset to the following settings:

Table 4-1b

Control Settings for Phase Mode Measurements

| <u>C TEST Range, pF</u> | <u>C MULT Setting</u> | <u>R/G MULT Setting</u> | <u>G DIAL Setting for PHASE Adjust</u> |
|-------------------------|-----------------------|-------------------------|----------------------------------------|
| 100 to 1000             | X1                    | X1                      | +1000 $\mu$ mhos                       |
| 10 to 100               | X0.1                  | X1                      | -100 $\mu$ mhos*                       |
| 1 to 10                 | X0.01                 | X10                     | -100 $\mu$ mhos*                       |
| 0.1 to 1                | X0.001                | X100                    | -100 $\mu$ mhos*                       |
| 0 to 0.1                | X0.0001               | X1000                   | -100 $\mu$ mhos*.                      |

\*Red sub-calibration farthest to the left from zero on the conductance scale.



Unless phase is correct, there will be an unbalance of the null. Adjust PHASE control to restore NULL INDICATOR reading to exactly center of scale.

1. The instrument is now ready for phase sensitive operation and it is necessary to balance only the CAPACITANCE dial when making a measurement. A meter reading above scale indicates the test capacitance is higher than the dial reading; a reading below center scale results when the test capacitance is lower than the dial reading.

### 2.2.3 Inductance Measurements

All preliminary procedures for inductance tests or measurements are identical to those for capacitance with the following exceptions:

- a. The C/L selector is placed in the L rather than the C position.
- b. The functions of the STANDARD and TEST terminals are reversed so that the test specimen is connected to the STD HI and LO remote terminals, rather than to the TEST terminals.

To determine the proper setting of the MULTIPLY C switch, convert the nominal value of the inductance to be measured (if known) to its equivalent capacitance value from the expression:

$$C = \frac{25.33}{L}$$

Where C = capacitance in picofarads

L = inductance in millihenries

To measure inductance, the bridge is balanced in exactly the same manner as for capacitance measurements. The inductance value is determined from the expression:

$$L = \frac{25.33}{C}$$

Where L = inductance in millihenries

C = capacitance in picofarads

NOTE: When measuring inductance above 100  $\mu$ H at 1 MHz, the distributed capacitance of the coil causes an appreciable increase in the "effective" inductance due to the increased impedance. The Model 75D measures the "effective" inductance - not the low frequency inductance.



#### 2.2.4 Differential Measurements

For differential measurements the reference capacitor is connected to the STD BNC receptacles and the test specimen to the TEST BNC receptacles. (Reverse procedure for inductance measurements.)

If temperature coefficient measurements are to be made, the reference capacitor is adjusted at the start of the test to equal the one being tested. The bridge is then set to a capacitance range that will give the desired resolution. For example: A 100 pF capacitor having a T.C. of +30 PPM/°C would have an increase in its differential capacitance of approximately 0.1 pF for an increase in temperature of 30°C.

If the differential measurement was made on the 0.001 MULTIPLY C range, the resulting change in capacitance (0.1 pF) would be 1/10 of full scale.

When testing capacitors of 10 pF or less for T.C., the C ZERO controls can be used in place of an external capacitor.



TABLE OF REPLACEABLE PARTS  
FOR MODEL 75D

NOTE: Components in the "Bridge" unit have not been included because, in general, their replacement must be followed by adjustments that require specialized equipment and techniques.

- CAPACITORS -

| Reference |          | Description   |            |      |                    | BEC Part No. |
|-----------|----------|---------------|------------|------|--------------------|--------------|
| C101      | Mylar    | 0.1 $\mu$ F   | $\pm 20\%$ | 200V | Sprague            | 230116       |
| C102      | Durmica  | 150 pF        | $\pm 5\%$  | 500V | Arco DM-15-151J    | 200032       |
| C103      | Mylar    | 0.002 $\mu$ F | $\pm 5\%$  | 200V | Sprague            | 234024       |
| C104      | Mylar    | 0.1 $\mu$ F   | $\pm 20\%$ | 200V | Sprague            | 230116       |
| C105      | Mylar    | 0.1 $\mu$ F   | $\pm 20\%$ | 200V | Sprague            | 230116       |
| C106      | Durmica  | 300 pF        | $\pm 5\%$  | 500V | Arco DM-15-301J    | 200034       |
| C107      | Var. Air | 3.5-15 pF     |            |      | Jackson Bros. C804 | 275143       |
| C108      | Mylar    | 0.002 pF      | $\pm 5\%$  | 200V | Sprague            | 234024       |
| C109      | Durmica  | 10 pF         | $\pm 5\%$  | 500V | Arco DM-10C-100J   | 200022       |
| C110      | Durmica  | 120 pF        | $\pm 5\%$  | 500V | Arco DM-15F-121J   | 200002       |
| C111      | Ceramic  | 36 pF         | $\pm 5\%$  | 500V | Erie N750          | 220117       |
| C112      | Mylar    | 0.1 $\mu$ F   | $\pm 20\%$ | 200V | Sprague            | 230116       |
| C113      | Durmica  | 300 pF        | $\pm 5\%$  | 500V | Arco DM-15-301J    | 200034       |
| C114      | Durmica  | 300 pF        | $\pm 5\%$  | 500V | Arco DM-15-301J    | 200034       |
| C115      | Mylar    | 0.1 $\mu$ F   | $\pm 20\%$ | 200V | Sprague            | 230116       |
| C116      | Mylar    | 0.1 $\mu$ F   | $\pm 20\%$ | 200V | Sprague            | 230116       |
| C117      | Mylar    | 0.1 $\mu$ F   | $\pm 20\%$ | 200V | Sprague            | 230116       |
| C118      | Ceramic  | 36 pF         | $\pm 5\%$  | 500V | Erie N750          | 220117       |
| C119      | Durmica  | 330 pF        | $\pm 1\%$  | 500V | Arco DM-15-331F    | 200033       |
| C120      | Durmica  | 330 pF        | $\pm 1\%$  | 500V | Arco DM-15-331F    | 200033       |
| C121      | Durmica  | 5 pF          | $\pm 1$ pF | 500V | Arco DM-10C-050    | 200043       |
| C122      | Mylar    | 0.1 $\mu$ F   | $\pm 20\%$ | 200V | Sprague            | 230116       |
| C123      | Durmica  | 300 pF        | $\pm 5\%$  | 500V | Arco DM-15-301J    | 200034       |
| C124      | Durmica  | 300 pF        | $\pm 5\%$  | 500V | Arco DM-15-301J    | 200034       |
| C125      | Durmica  | 120 pF        | $\pm 5\%$  | 500V | Arco DM-15-121J    | 200002       |
| C126      | Mylar    | 0.01 $\mu$ F  | $\pm 20\%$ | 200V | Sprague            | 234027       |



| <u>Reference</u> | <u>Description</u> |                 |            |      |                 | <u>BEC Part No.</u> |
|------------------|--------------------|-----------------|------------|------|-----------------|---------------------|
| C127             | Mylar              | 0.01 $\mu$ F    | $\pm 20\%$ | 200V | Sprague         | 234027              |
| C128             | Mylar              | 0.002 $\mu$ F   | $\pm 5\%$  | 200V | Sprague         | 234024              |
| C129             | Durmica            | 120 pF          | $\pm 5\%$  | 500V | Arco DM-15-121J | 200002              |
| C130             | Durmica            | 120 pF          | $\pm 5\%$  | 500V | Arco DM-15-121J | 200002              |
| C131             | Mylar              | 6800 pF         | $\pm 10\%$ | 200V | Sprague         | 234044              |
| C132             | Mylar              | 0.1 $\mu$ F     | $\pm 20\%$ | 200V | Sprague         | 230116              |
| C133             | Durmica            | 300 pF          | $\pm 5\%$  | 500V | Arco DM-15-301J | 200034              |
| C134             | Durmica            | 300 pF          | $\pm 5\%$  | 500V | Arco DM-15-301J | 200034              |
| C135             | Durmica            | 300 pF          | $\pm 5\%$  | 500V | Arco DM-15-301J | 200034              |
| C136             | Durmica            | 300 pF          | $\pm 5\%$  | 500V | Arco DM-15-301J | 200034              |
| C137             | Mylar              | 0.1 $\mu$ F     | $\pm 20\%$ | 200V | Sprague         | 230116              |
| C138             | Mylar              | 0.002 $\mu$ F   | $\pm 5\%$  | 200V | Sprague         | 234024              |
| C139             | Mylar              | 0.047 $\mu$ F   | $\pm 10\%$ | 400V | Sprague         | 234047              |
| C140             | Mylar              | 0.002 $\mu$ F   | $\pm 5\%$  | 200V | Sprague         | 234024              |
| C201             | Mylar              | 0.047 $\mu$ F   | $\pm 10\%$ | 400V | Sprague         | 234047              |
| C401a,b          | Electrolytic       | 500-500 $\mu$ F |            | 450V | Mallory         | 283142              |
| C402a,b          | Electrolytic       | 20-20 $\mu$ F   |            | 450V | Mallory         | 283100              |

- RESISTORS -

| <u>Reference</u> | <u>Description</u> |              |           |          |            | <u>BEC Part No.</u> |
|------------------|--------------------|--------------|-----------|----------|------------|---------------------|
| R101             | Comp.              | 220K         | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301143              |
| R102             | Comp.              | 2.2K         | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301095              |
| R103             | Comp.              | 22K          | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301119              |
| R104             | Comp.              | 470 $\Omega$ | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301079              |
| R105             | Comp.              | 100 $\Omega$ | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301063              |
| R106             | Comp.              | 22K          | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301119              |
| R107             | Comp.              | 220K         | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301143              |
| R108             | Comp.              | 220K         | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301143              |
| R109             | Comp.              | 470 $\Omega$ | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301079              |
| R110             | Comp.              | 2.2K         | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301095              |
| R111             | Comp.              | 100 $\Omega$ | $\pm 5\%$ | 1/2 Watt | AB Type EB | 301063              |



| <u>Reference</u> |       | <u>Description</u> |      |           |                    | <u>BEC Part No.</u> |
|------------------|-------|--------------------|------|-----------|--------------------|---------------------|
| R112             | Comp. | 22K                | ±5%  | 1/2 Watt  | AB Type EB         | 301119              |
| R113             | Comp. | 2.2K               | ±5%  | 1/2 Watt  | AB Type EB         | 301095              |
| R114             | Comp. | 470Ω               | ±5%  | 1/2 Watt  | AB Type EB         | 301079              |
| R115             | Comp. | 10K                | ±5%  | 1/2 Watt  | AB Type EB         | 301111              |
| R116             | Comp. | 1M                 | ±5%  | 1/2 Watt  | AB Type EB         | 301159              |
| R117             | Comp. | 1M                 | ±5%  | 1/2 Watt  | AB Type EB         | 301159              |
| R118             | Comp. | 470K               | ±5%  | 1/2 Watt  | AB Type EB         | 301151              |
| R119             | Comp. | 47K                | ±5%  | 1/2 Watt  | AB Type EB         | 301127              |
| R120             | Comp. | 470Ω               | ±5%  | 1/2 Watt  | AB Type EB         | 301079              |
| R121             | Comp. | 10K                | ±5%  | 1/2 Watt  | AB Type EB         | 301111              |
| R122             | Comp. | 22K                | ±5%  | 1/2 Watt  | AB Type EB         | 301119              |
| R123             | Comp. | 47K                | ±5%  | 1/2 Watt  | AB Type EB         | 301127              |
| R124             | Comp. | 1K                 | ±5%  | 1/2 Watt  | AB Type EB         | 301087              |
| R125             | Comp. | 470K               | ±5%  | 1/2 Watt  | AB Type EB         | 301151              |
| R126             | Comp. | 10Ω                | ±5%  | 1/2 Watt  | AB Type EB         | 301039              |
| R127             | Var.  | 5K                 | ±20% | 3/8 Watt  | CTS Type 330P      | 311222              |
| R128             | Comp. | 680K               | ±5%  | 1/2 Watt  | AB Type EB         | 301155              |
| R129             | Comp. | 2.2M               | ±5%  | 1/2 Watt  | AB Type EB         | 301167              |
| R130             | Comp. | 2.2K               | ±5%  | 1/2 Watt  | AB Type EB         | 301095              |
| R131             | Comp. | 10K                | ±5%  | 1 Watt    | AB Type GB         | 302125              |
| R132             | Comp. | 510K               | ±5%  | 1/2 Watt  | AB Type EB         | 301152              |
| R133             | Var.  | 2K                 | ±10% | 1/2 Watt  | Bourns 200L-1-202M | 311217              |
| R134             | Comp. | 510K               | ±5%  | 1/2 Watt  | AB Type EB         | 301152              |
| R135             | Comp. | 510K               | ±5%  | 1/2 Watt  | AB Type EB         | 301152              |
| R136             | Comp. | 510K               | ±5%  | 1/2 Watt  | AB Type EB         | 301152              |
| R137             | Comp. | 7.5K               | ±5%  | 1/2 Watt  | AB Type EB         | 301108              |
| R138             | Comp. | 1M                 | ±5%  | 1/2 Watt  | AB Type EB         | 301159              |
| R139             | Var.  | 50K                | ±10% | 2 Watt    | AB Type J          | 311125              |
| R140             | Var.  | 100K               | ±10% | 1/10 Watt | CRL-BA-001-385     | 311121              |
| R141             | Comp. | 10K                | ±5%  | 1/2 Watt  | AB Type EB         | 301111              |
| R142             | Comp. | 1M                 | ±5%  | 1/2 Watt  | AB Type EB         | 301159              |



| <u>Reference</u> | <u>Description</u> |      |      |                   |              | <u>BEC Part No.</u> |
|------------------|--------------------|------|------|-------------------|--------------|---------------------|
| R201             | Var. W.W.          | 50K  | ±5%  | 10 Turn Clarostat | 62-JA-50K    | 311198              |
| R202             | Comp.              | 24K  | ±5%  | 2 Watt            | AB Type HB   | 304120              |
| R305             | Var.               | 5K   | ±10% | 2 Watt            | AB Type J    | 311202              |
| R401             | Comp.              | 2K   | ±5%  | 1/2 Watt          | AB Type EB   | 301094              |
| R402             | Comp.              | 1M   | ±20% | 1 Watt            | AB Type GB   | 302128              |
| R403             | W.W.               | 2K   | ±5%  | 5-1/4 Watt        | Ohmite #2901 | 310110              |
| R404             | Comp.              | 120Ω | ±5%  | 1/2 Watt          | AB Type EB   | 301065              |
| R405             | Comp.              | 2.2Ω | ±5%  | 1/2 Watt          | AB Type EB   | 301501              |

- DIODES -

| <u>Reference</u> | <u>Description</u> |        |                  |  | <u>BEC Part No.</u> |
|------------------|--------------------|--------|------------------|--|---------------------|
| CR101            | Silicon            | 1N251  | Texas Instrument |  | 530043              |
| CR102            | Silicon            | 1N914  | Texas Instrument |  | 530058              |
| CR103            | Silicon            | 1N914  | Texas Instrument |  | 530058              |
| CR104            | Germanium          | 1N58A  | Sylvania         |  | 530021              |
| CR105            | Germanium          | 1N58A  | Sylvania         |  | 530021              |
| CR106            | Silicon            | 1N914  | Texas Instrument |  | 530058              |
| CR107            | Germanium          | 1N58A  | Sylvania         |  | 530021              |
| CR108            | Silicon            | 1N251  | Texas Instrument |  | 530043              |
| CR401            | Silicon Bridge     | SPF-GR | Solitron         |  | 532006              |
| CR402            | 6.2V Zener         | 1N753  | Motorola         |  | 530062              |
| CR403            | 6.8V Zener         | UZ806  | Unitrode         |  | 530041              |

- TRANSISTORS -

| <u>Reference</u> | <u>Description</u> |       |                  |  | <u>BEC Part No.</u> |
|------------------|--------------------|-------|------------------|--|---------------------|
| Q401             | PNP                | 2N404 | Texas Instrument |  | 528009              |
| Q402             | PNP                | 2N554 | Motorola         |  | 528003              |



- TUBES -

| <u>Reference</u> | <u>Description</u> | <u>BEC Part No.</u> |
|------------------|--------------------|---------------------|
| V101             | 6AU6               | 526 6AU6            |
| V102             | 6AU6               | 526 6AU6            |
| V103             | 6AU6               | 526 6AU6            |
| V104             | 6AU6               | 526 6AU6            |
| V105             | 6AU6               | 526 6AU6            |
| V106             | 12AT7              | 526 12AT7           |
| V107             | 12AT7              | 526 12AT7           |
| V401             | 6X4                | 526 6X4             |
| V402             | 0A2                | 526 0A2             |

- INDUCTORS -

| <u>Reference</u>                                              | <u>Description</u>                         | <u>BEC Part No.</u> |
|---------------------------------------------------------------|--------------------------------------------|---------------------|
| L101    Var.    RF                                            | 100-175 $\mu$ H    North Hills 1500A       | 400115              |
| L102            RF                                            | 1000 $\mu$ H            Stanwyck Dink-1000 | 400135              |
| L103            RF                                            | 1000 $\mu$ H            Essex              | 400095              |
| L104    Var.    RF                                            | 100-175 $\mu$ H    North Hills 1500A       | 400115              |
| L105            RF                                            | 1500 $\mu$ H            Stanwyck Dink-1500 | 400136              |
| L106    Var.    RF                                            | 100-175 $\mu$ H    North Hills 1500A       | 400115              |
| L107    Var.    RF                                            | 100-175 $\mu$ H    North Hills 1500A       | 400115              |
| L108            RF                                            | 1000 $\mu$ H            Essex              | 400095              |
| L401    Power        7H   500 $\Omega$ 50 mA    Stancor C1707 |                                            | 440001              |

- TRANSFORMERS -

| <u>Reference</u> | <u>Description</u>              | <u>BEC Part No.</u> |
|------------------|---------------------------------|---------------------|
| T401             | 12.6V Filament    Stancor P8130 | 446010              |
| T402             | Power              Stancor 1377 | 446007              |



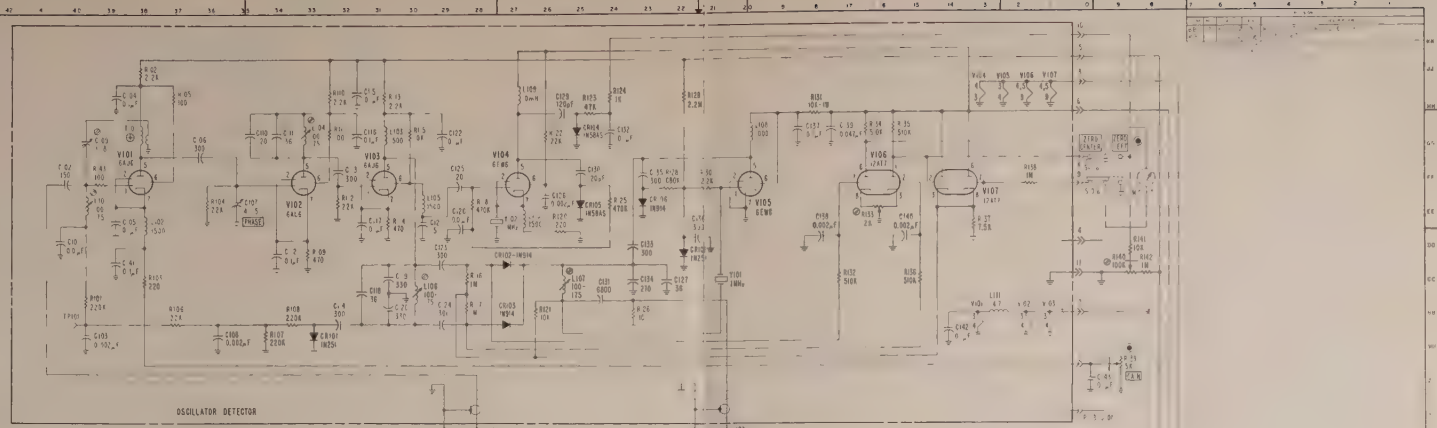
- SWITCHES -

| <u>Reference</u> | <u>Description</u> |                             | <u>BEC Part No.</u> |
|------------------|--------------------|-----------------------------|---------------------|
| S101a,b          | Slide DPDT         | Continental Wirt Type G-326 | 465125              |
| S201a,b          | Rotary 2P - 4 Pos  | Oak Type J                  | 466171              |
| S401             | Toggle SPST        | Carling #110-63             | 465105              |

- MISCELLANEOUS -

|       |                |                 |                      |        |
|-------|----------------|-----------------|----------------------|--------|
| M101  | Meter          | 50-0-50 $\mu$ A | Ammon Type AM-3      | 554181 |
| Y101  | Crystal        | 1 MHz           | James Knight CR 18/U | 547015 |
| F401  | Fuse (Slo Blo) | 0.5A @ 250V     | Buss MDL 1/2         | 545504 |
| PL401 | Lamp           | 14V 80 mA       | GE Type 330          | 545110 |

2



RESISTANCE VALUES IN OHMS AND 1/2 WATT  
UNLESS OTHERWISE SPECIFIED

CAPACITANCE VALUES IN  $\mu$ F UNLESS OTHERWISE SPECIFIED

INDUCTANCE VALUES IN  $\mu$ H UNLESS OTHERWISE SPECIFIED

$R \times 10^3 = R \times 10^3$

INTERNAL CONTROL

EXTERNAL CONTROL

ALL PIPERFECTORS SHOWN PUTTING IN  
CLOCKWISE DIRECTION

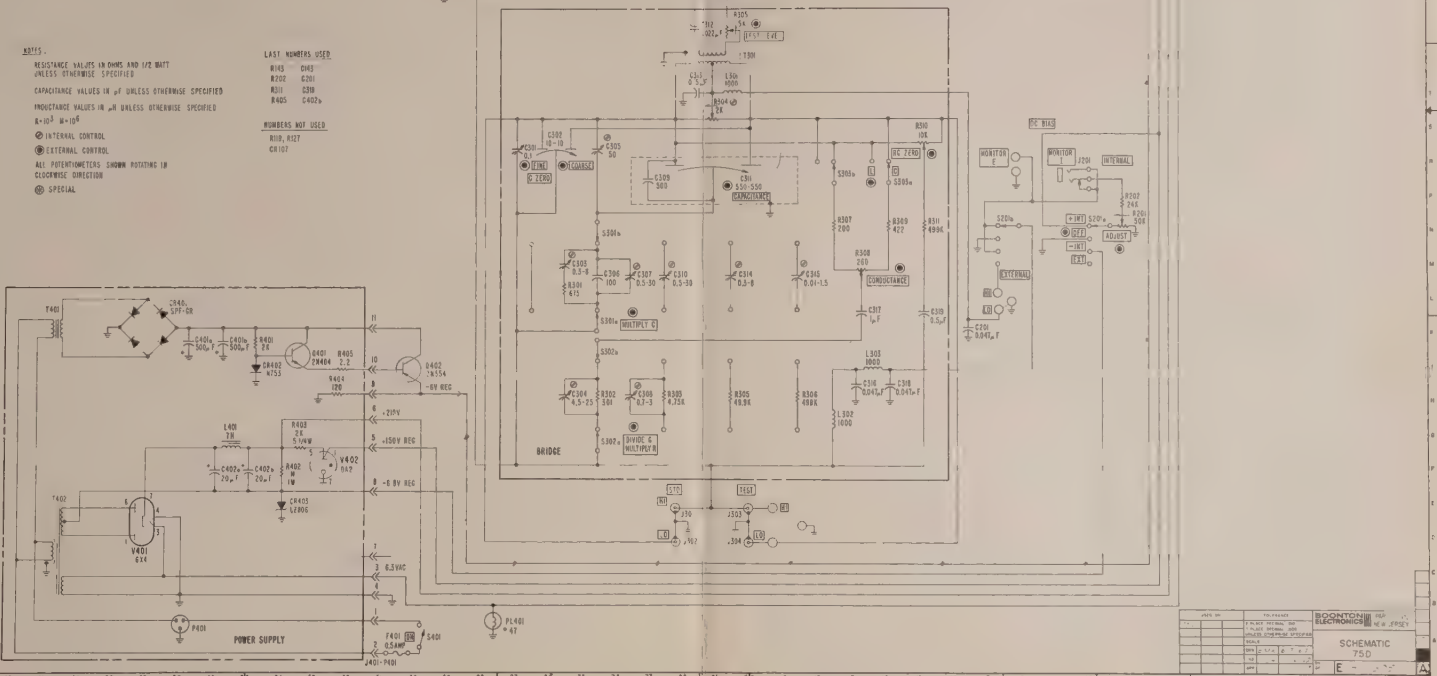
SPECIAL

#### LAST NUMBERS USED

R103 C401  
R105 C301  
R101 C30  
R405 C402

#### NUMBERS NOT USED

R101, R102  
C107



| DATE    | REV | BY       | CHKD     | DESCRIPTION |
|---------|-----|----------|----------|-------------|
| 10-1-60 | 1   | J. H. H. | J. H. H. | SCHEMATIC   |
| 10-1-60 | 2   | J. H. H. | J. H. H. | 75.0        |
| 10-1-60 | 3   | J. H. H. | J. H. H. |             |
| 10-1-60 | 4   | J. H. H. | J. H. H. |             |
| 10-1-60 | 5   | J. H. H. | J. H. H. |             |



## Warranty

Boonton Electronics Corporation warrants its products to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to vacuum tubes that have given normal service, to sealed assemblies which have been opened, or to any item which has been repaired or altered without our authorization.

We will repair or, at our option, replace at no charge any of our products which are found to be defective under the terms of this warranty.

## SHIPPING INSTRUCTIONS

If it becomes necessary to ship the instrument, the following steps should be followed:

- a. Wrap the instrument with heavy wrapping paper and seal the seams with gummed tape. Place in fibreboard carton large enough to permit three inches of soft packing material between instrument and sides of box.
- b. Alternatively Boonton Electronics will provide an appropriate shipping container and packing materials at nominal cost. These may be obtained by writing to the Sales Department, Boonton Electronics Corporation, Route 287 at Smith Rd., Parsippany, N. J. 07054.

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## SHIPPING INSTRUCTIONS

If it becomes necessary to ship the instrument, the following steps should be followed:

a. Wrap the instrument with heavy wrapping paper and seal the seams with gummed tape. Place in cardboard carton large enough to permit three inches of soft packing material between instrument and sides of box.

b. Alternatively Boonton Electronics will provide an appropriate shipping container and packing material at nominal cost. These may be obtained by writing to the Sales Department, Boonton Electronics Corporation, Route 287, St. Smith Rd., Parsippany, N. J. 07054.



MP MASTER



MA24785